PUBLIC WORKS

CITY COUNTY STATE

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JANUARY 28, 1922

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CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 JANUARY 28, 1922 No. 4

Utilizing Small Stream Valleys for Traffic Routes*

By Jay Downer †

How the Bronx River, which with its banks had become a public nuisance, was turned into an attractive location for a great pleasure traffic route. An illustration of the improvement is shown on the front cover

The valleys of our larger streams are so commonly used for traffic routes that it is quite unnecessary to call attention to their advantages. This discussion is, therefore, limited to the protection and use of small stream valleys in the vicinity of centers of population. In the beginning we may as well face the fact that every small stream valley in or about a center of population is destined to be either a substantial asset or a definite liability to the city through which it flows. If it is taken in hand, protected and utilized, with marginal lands acquired by the municipality, it will usually afford excellent location for traffic routes, trunk sewer lines and parkways, which will substantially increase property values in its zone. While on the other hand, if left to shift for itself, unprotected, such a stream valley is almost certain to degenerate into a nuisance zone with distinctly depressing influence on property values and, with the growth of population, presenting an increasingly difficult problem, which ultimately must be solved at a cost for abating the nuisance that may easily be many times the cost of providing a parkway and important traffic route, if reasonable foresight had been exercised.

As an illustration of the problem I will describe how a particular case—that of the Bronx river in and adjacent to the city of New York— has been reclaimed and utilized for what is destined to become one of the world's greatest pleasure traffic routes—the Bronx River Parkway.

The Bronx River Parkway Reservation extends for a distance of 15 miles, from the Botanical Gardens of Bronx Park, in New York City, to the great Kensico dam, four miles north of White Plains, the county seat of Westchester county. The Bronx river is a small stream coming down out of the Westchester hills and emptying into Long Island Sound. It has a beautiful valley between ridges roughly parallel north and south. Bold and rocky in some places, there are expanses of meadow land in other portions; in short, the diversity of scenery that Westchester county is noted for. The New York and Harlem railroad closely follows this water course and with the development of towns and villages along this railroad there came the inevitable sewage pollution and discharge of factory wastes. The Bronx river went from bad to worse year after year and served as a channel to convey the accumulated filth of the valley towns such as White Plains, Mount Vernon and the upper portion of Bronx Borough, into Bronx Park, through which the river flows and enlarges into several small lakes. Unfit for decent human habitation, the river banks in the towns were cluttered with stables, shacks and small factories, which, with the stream itself, formed an unsanitary nuisance affecting extended areas.

More than 25 years ago, in 1895, the polluted condition of the Bronx river attracted sufficient attention to bring about the appointment by the Governor of an investigating commission. This commission employed an engineer, who wisely recommended that the low lands along the river be acquired, not only to fully protect the river from pollution, but to provide ample width for a trunk sewer and an important traffic route or parkway drive. The shortsightedness of those commissioners in refusing to adopt the recommendations of their engineer has cost the people of New York City and Westchester county many millions of dollars, for if the parkway had been established at that time, the necessary lands could have been acquired at a mere fraction—certainly not more than one-fifth—of the present cost. This 1895 commission recommended instead that a sanitary trunk sewer be built parallel

* Paper before American Road Congress, Chicago, Ill., Jan. 18, 1922.

† Chief Engineer, Bronx Parkway Commission, New York.

to the river. The question of enclosing the entire river in a big storm sewer was discussed, but discarded, it being impracticable to build a storm sewer large enough to carry the flood waters. That commission's recommendation to expend a large sum for the construction of a sanitary sewer did not appeal to the public imagination and nothing resulted therefrom.

Ten years elapsed and it became absolutely necessary from a sanitary standpoint to clean up the situation. Another investigating commission was appointed in 1906, which recommended that the most feasible solution, having regard for economy and return in public utility, was the creation of a parkway reservation, which would include the low lands and immediate slopes along either side of the river. The commission pointed out that this was the cheapest way to protect the river and that the land to be acquired would provide locations not only for a sanitary sewer, but for a great parkway with traffic artery extending from New York City's park system 15 miles along the picturesque river to the magnificent Kensico dam and reservoir, where the city owns 4,500 acres of beautiful woodland and lake areas. These recommendations were adopted as a joint project of New York City and Westchester county, and the legislative act provided for acquiring about 1,200 acres of land along the river, elimination of sewerage pollution and development of a parkway.

With the passing of time there had been a steady increase in land values in all suburban districts around New York City, and lands in the Bronx river valley, which could have been acquired a few years earlier at much lower cost, had so advanced that the 1,200 acres worth 25 years ago, perhaps, one and a half to two million dollars, are now costing in spite of the utmost economy in acquisition, upwards of $8,000,000. In the meantime, the natural beauty of certain sections of the valley had been almost totally destroyed and the restoration of these sections has added to the heavy cost of delay in starting the project. The Parkway Commission, however, made the best of the situation and as soon as the lands were acquired, the nuisances were abated, garbage and refused cleaned up, and over one hundred and fifty cases of pollution were eliminated. With the river and reservation finally clean, the commission found itself, in 1919, with the funds in hand for proceeding with the improvement program, the main feature of which was the construction of a parkway drive 40 feet in width connecting the city's boulevards at Bronx Park with the magnificent system of state roads diverging from the northerly terminus of the new parkway at Kensico dam.

This 40-foot driveway, located in a parkway reservation, varying in width from 200 to 1,200 feet, with an average width of 600 feet, will provide an outlet for pleasure traffic of tremendous value to the great metropolis. The work of constructing the driveway is about one-half finished and the traffic on the sections already opened indicates that the driveway will be used to capacity when completed at the end of 1923.

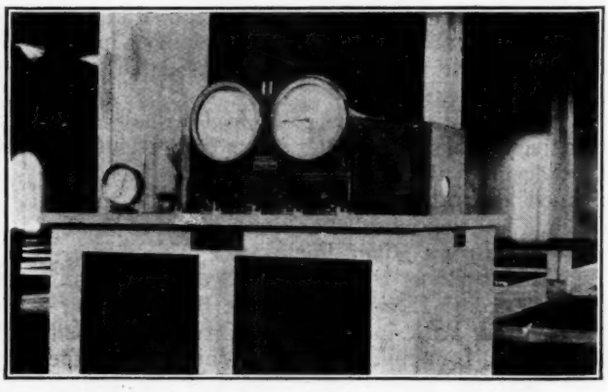
The work done by the Commission includes the elimination of nuisances, removal of the 355 shacks and third-rate buildings, drainage of swampy areas, regulations of river, filling and grading, and finally the construction of bridges and paving of the driveway with concrete base and asphaltic surface. There were many picturesque features, which the Commission was able to preserve in the upper portions of the reservation, which were more remote from centers of population.

Duluth Planning by Engineers' Club

The Duluth Engineers' Club has been asked by the Civic Council, which represents a number of civic organizations, to submit a general plan for sewage disposal and water supply, this action having been taken at the request of the Duluth Board of Realtors. It is not felt that any particular crisis exists at this time, but this move is made in order to anticipate any future necessities. The water used by the city is withdrawn from the lake into which the city discharges its sewage, and is now being treated with chlorine, apparently satisfactorily, but as the population increases it will probably become necessary either to move the intake beyond its present position nine miles from shore or to secure a more complete treatment of the water. The chief point which it is desired that the Engineers' Club advise the city on is whether the treatment of the sewage or some change in the taking and purifying of the water would be the preferable solution.

Sensitive Turbidity Detection

In our issue of January 7th we described a device which had been developed at the Montebello filters, Baltimore, for sensitive detection of suspended matters and turbidity in the effluent from the filters. After the article had been received from Mr. Baylis, he sent us a photograph showing one of the turbidity detectors mounted on an operating table at the Montebello filters. Owing to a strike of the engravers in New York we were unable to have an illustration prepared from this photograph in time for the January 7th issue, but we are presenting the cut herewith. This gives an idea of the size and general appearance of the box containing the appliance. The observation hole will be seen on the side of the box near the right hand end of the table.



TURBIDITY DETECTOR ON OPERATING TABLE AT MONTEBELLO FILTERS

Sewage Treatment in Imhoff Tanks*

By Russell Riker

Details of design, including settling chamber, scum boards, baffles, slots, gas vents, sludge digestion chambers, scum troughs, sludge beds, etc.. Instructions for operating tanks.

Settling Chamber: The ratio of the width of the settling chamber to the length should not be greater than one to five. The depth should be such as to keep the velocity as low as possible. If the velocity is kept low the length can be reduced. Dr. Imhoff recommends .03 foot per second with a maximum of 0.1 foot per second for maximum flows. The velocity used in the design of New Jersey longitudinal flow tanks ranges from .02 to 0.1 foot per second. This velocity has been increased in a number of cases where not all of the original tanks have been used or where the flow is greatly increased over the original estimate. At Plainfield the velocity has been increased one-third and at Princeton from .04 to .12 foot per second. Experiments at Columbus indicate that a velocity of .013 gave a good reduction in the settleable solids. Experiments carried out with current meter at Plainfield would indicate that the velocity does not remain the same at any two places in the tank. Sections taken across the tank indicate that the velocity is speeded up near the side walls. We have found that there is a great difference between velocity at different depths in the tank. Aniline dye placed in the inlet end of the settling tanks has appeared at the outlet end in twenty minutes where the normal detention of the tank was several hours, indicating that the surface velocity was very much higher than the other velocities.

The economical capacity of the settling chamber should be such as to give the sewage 1½ hours' average detention, based on the average flow per 24 hours. Dr. Imhoff used 1½ hours for the detention period for German design, but recommended 2 or even 3 hours for weaker American sewage. Provided the velocity is low enough, the greater amount of settleable material will settle out in the first 15 feet of travel, leaving fine colloidal material that will take hours to settle out. It has been found where an Imhoff tank has three or more sludge compartments, the central compartment or compartments have practically no sludge in them. The original army tank was also a good example of this phenomnon. A review of the detention period in the New Jersey Imhoff tanks indicates a minimum detention period of 1½ hours and a maximum of 4 hours.

The sloping side walls vary from 1 to 1 for the Westfield plant to 1 to 1½ for the Oaklyn plant. Experience indicates that the side walls of the Westfield plant do not have enough slope, this in spite of the fact that George D. Hammond in his experiments at Brooklyn found that side walls with as low a slope as 42° proved satisfactory. The success of the operation at Brooklyn may, however, be due to the type of slot used at that station, which will be discussed later. The average slope used with success is 1 horizontal to 1.3 vertical. The top of the side walls of the settling chamber should be provided with walks so that the attendant can easily skim the settling chamber.

Scum Boards and Baffles: Contrary to the results obtained in Mr. Hammond's recent investigations at Brooklyn, experience in New Jersey indicates that deep baffles are not necessary. Very few of the plants have deep baffles, while at some places where deep baffles were originally constructed they have been withdrawn and good sedimentation has been obtained with the majority of these tanks. Most of the designs call for a scum board at the influent and effluent ends about 2 feet from the weirs. It is not wise to place the scum board too close to the weirs as the increase in velocity at this point may draw some of the floating material over into the effluent.

Slots: It is believed that the type of slot recommended by Mr. Hammond is a decided improvement over the old design. In the former design one or both planes of the sloping sides walls of the settling chamber were obstructed, but in this design an "A" shaped gas deflector has its upper surface in the same plane as the slopes of the settling chamber, allowing a free fall into the lower compartment. Several plants have slots constructed in such a manner in New Jersey. These plants have caused noticeably less trouble in cleaning the side walls. With such a design it may be possible to use a 6-inch slot with success, but our experience in New Jersey, where the majority of slots are 6 inches, would in-

CHIMNEY TYPE OF GAS VENTS

*Continued from page 42.

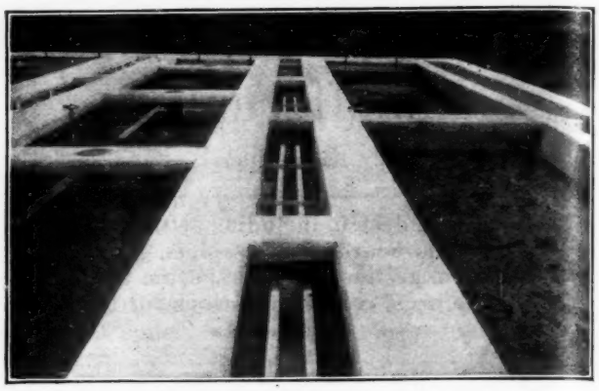
dicate that a slot 8 inches in width is advisable. The gas deflector or bottom of the sloping side walls of the settling chamber should be so constructed as not to interfere or hold back any sludge in the process of rising or falling. At Princeton it is believed that the peculiar construction of the bottom of the side walls and gas deflector catches much sludge and holds it in suspension.

Gas Vents and Scum Chambers: There are several different forms of gas vents; the most popular of these being the longitudinal rectangular gas vents, the chimney gas vents and the segment gas vents. The form bears a close relation to the area, which has been much discussed by engineers. Some think that it should be as small as possible and the chimney as well as the segment type illustrates the practical application of this idea. Other engineers advocate very large gas vents.

Experience in this state would indicate that longitudinal gas vents running the entire length of the tank are the better. A small gas vent is easier to work and perhaps keeps the floating scum waterlogged, but large areas give the floating sludge more of a chance to rise to the surface and liberate its entrained gas. It has been found, however, that too little attention has been given to the capacity of the scum chambers, that portion of the gas vents above the slot, and it is suggested that the capacity of this chamber be as great as the capacity of the sludge digestion chamber. The per cent which the area of the gas vent is to the area of the settling tank ranges from less than 5% to 44%. We cannot recommend that a certain area will prove satisfactory, although it can be stated that the areas of the gas vents in New Jersey tanks are in general too small and that foaming over the top of the gas vents very seldom occurs with large gas vents. Large gas vents do not prevent belching or rising of the floating sludge through the slot to the surface of the detention chamber.

Sludge Digestion Chamber: The sludge digestion chamber may be round or rectangular. The round sludge chamber may give the better results, but it is not thought that the increased cost of construction pays for the results obtained. Of course, it is advantageous to eliminate any dead area where digested sludge may collect and not mix with the incoming fresh sewage. Capacities range from 0.7 to 1.9 cubic feet per capita, averaging slightly above 1 cubic foot per capita. A capactiy of over 2 cubic feet per capita is preferred.

The bottom of the sludge chamber should be in the shape of a cone or truncated pyramid and the greater the slope of the walls of this chamber the better. The sludge chamber is usually divided into square compartments and sludge drawing facilities are provided for each compartment. The greatest trouble with such a division is that the good and bad sludge do not mix properly. Attempts have been made to cut holes in the partition walls but this has not improved operation. Of course, the heavier larger particles will settle in the primary compartment, with correspondingly poorer sludge in the succeeding compartments. Reversing the flow helps out the two end compartments but the good sludge in the central compartments does not mix with the fresh sludge. It hardly seems necessary to construct such division walls.



NARROW GAS VENT WITH TROUGH IN WESTMONT

Sludge Pipes: The average sludge pipe size is 8 inches. Care should be taken that the end of the pipe is neither too near nor yet too far from the concrete side walls or bottom. If screens and grit chambers are used they should not become clogged.

Scum Pipes or Troughs: Experience indicates that at practically all plants, scum collects in large quantities in the gas vents. Usually this scum is well digested and odorless and it can be drawn off on the sludge bed. Due to the large gas content it dries faster than the bottom sludge. It is suggested that apparatus for removal of floating sludge or scum be installed. Pipes or troughs can be constructed at little additional expense and may be a great saving in the end. This conveyor should be constructed about 1 foot below the water level.

Such a design has been followed in the construction of the Haddonfield and Westmont sewage treatment plants. At the end of the longitudinal gas vent is a sluice gate. This gate opens into a small concreted box, the bottom of which contains an opening to a 6-inch pipe leading to the main sludge bed. In the gas vent (which is longitudinal) a narrow, deep steel trough runs the entire length, connecting with the sluice gate at the end. The top of the longitudinal trough is at the same elevation, a few inches above the water level, throughout. The bottom is given sufficient grade toward the sluice gate in order to allow for a good velocity of flow in the trough. To facilitate the flow in the trough, the bottom of it is connected with the settling chamber by pipes so that, by opening a valve, water enters the trough under a small head equal to the difference between the level of water in the settling chamber and the bottom of the trough. These tanks have been in operation only a short time and we are unable to state with what success the trough will operate, although there is some objection to obstructing the gas vent area even with sludge pipes; also it may prevent the breaking of frozen floating scum.

Sludge Beds: It is generally agreed that sludge bed area must be made larger, especially with the climate in New Jersey where not more than ten dryings per bed can be obtained per year. At Plainfield, where no industrial wastes are treated, Mr. Downes has obtained but 5.8, 6.0 and 5.8 dryings per bed for the last three years. He has made

the following computation: "Assuming that the depth of sludge on the bed is 9 inches and that the actual amount of sludge discharged from the tanks is 108,000 cubic feet from 35,000 population, the sludge bed area needed is equal to 144,000 square feet drying surface per year and $\frac{144,000}{6} = 24,000$ square feet drying area to care for 35,000 persons, or .686 square foot per capita."

OPERATION

When the two-story tank was first introduced the general impression was that it would operate satisfactorily with every little attention. After a short survey of early American experience with the tank, Dr. Imhoff stated that it would be necessary to remove the light floating material on the surface of the tank about twice a week.

WIDE GAS VENT WITH TROUGH, HADDONFIELD

Not until March, 1914, did any definite set of operating instructions appear. These instructions with modifications are sent to each operator of Imhoff tanks in the State of New Jersey and are as follows:

New Jersey Instructions for Operating Imhoff Tanks

1. *SCREENS AND GRIT CHAMBER.* If your plant includes screens and grit chamber, clean them regularly. Large floating matter or sand should not be allowed to enter the tanks.

2. *FLUSHING SEWERS.* Flush the sewerage system regularly. Remember the operation of the plant depends to a large degree on the character of the raw sewage.

3. *GREASE.* Eliminate as much grease from the raw sewage as possible. It interferes with the proper digestion of the sludge.

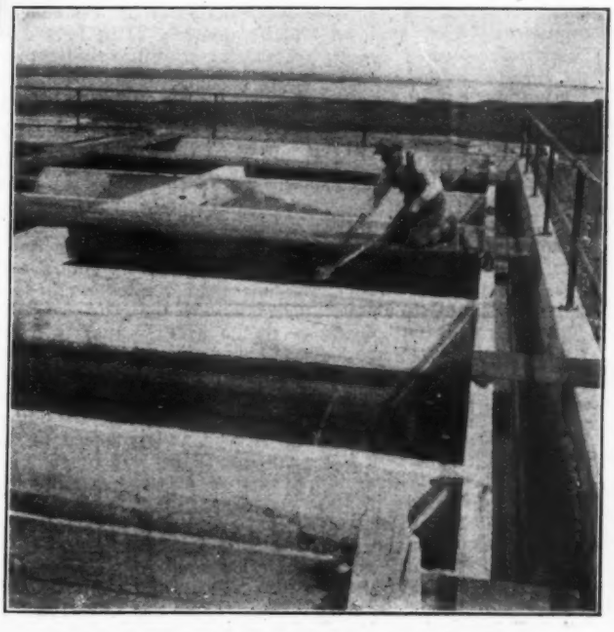
4. *CLEANING SIDES AND SLOTS OF SEDIMENTATION CHAMBERS.* Twice a week the walls and sloping bottoms of sedimentation chambers should be cleaned with a rubber squeegee (a flat hardwood board from 12 to 14 inches long and from 3 to 4 inches wide with rubber edges and a light wooden handle of length determined by the dimensions of the chambers) and all adhering solid matters pushed down through the slots. Floating materials, such as matches, corks, etc., behind baffles and all scum collecting upon the surface of the sewage passing through the chambers should be removed daily. This may be done by means of a dish-shaped perforated skimmer, perhaps 18 to 20 inches in diameter, attached to a long wooden handle. The scum and floating material should be buried. *Do not place it in the gas vents.*

5. *REVERSAL OF FLOW.* The flow should be reversed in direction through the tanks at least once a month. This is very desirable in order that the sludge collecting in the several wells may be maintained as nearly as possible uniform in composition and volume. Be sure to clean all floating material from inlet weir before changing.

6. *BREAKING UP AND REMOVAL OF SCUM IN GAS VENTS.* Every day the scum collecting in the gas vents should be thoroughly broken up with a rake or water jet from garden hose and pushed down into the digestion chambers. Use only enough water to loosen the scum. If this is not faithfully and consistently done at sufficiently frequent intervals scum may collect to excessive depths in the gas vents. Great depths of scum will not digest properly, and may give off more or less offensive odors of decomposition, and will eventually cause the gas-laden sludge to be forced up through the slot into the sedimentation chamber. If, in spite of frequent and thorough agitation, the scum layers become too deep, dense and hard and cannot be made to deposit in the digestion chambers, they should be removed by means of shovels. This is very important. The scum may be taken to a sludge drying bed and there covered with a generous sprinkling of lime, or if the area available is not sufficient or the scum too offensive, should be buried. If the gas vents can be connected to the sludge removal pipe, the scum can be run directly to the sludge beds. Enough water to thin it out should be added.

7. *LIME TREATMENT FOR ACID SEWAGE.* Whenever the litmus test shows an acid reaction in the raw sewage, milk of lime should be added in quantity sufficient to neutralize this acidity. The quantity of lime required will depend upon the acidity of the sewage, but unless the situation is complicated by the dumping of acid manufacturing wastes into the sewers, should not exceed 100 pounds per million gallons treated. All manufacturers found to be loading the system up with such wastes should be forced to neutralize the same before leaving their plant. The adding of lime to sludge through the gas vents is not advised. It may cause a more putrescible sludge than otherwise.

8. *OBSERVATION OF RATE OF DEPOSITION OF SLUDGE.* The rate of deposition of the sludge in the digestion chambers should be carefully watched, and the elevation of its surface should be determined twice a month.



REMOVING SCUM FROM TANK AT VENTNOR

This may be done by means of a weighted board or sheet iron plate from 12 to 18 inches square attached to a wire or cord or to a long light rod of wood lowered through the central slot. Sludge should not be allowed to accumulate to a greater depth than 1 foot below the slots.

9. *REMOVAL OF SLUDGE.* Sludge in small quantities should be drawn from the tank about once a month, in summer more frequently. The amount withdrawn at any one time should not be too great. In the first place only well digested sludge should be removed. Again, it is better, at least in large plants, to remove relatively small amounts of sludge at frequent intervals than to withdraw very large quantities infrequently. Great care should be taken not to allow the sludge *to pass too rapidly* out through the sludge withdrawal pipes because the less well digested and softer sludge nearer the surface may be forced by the water pressure out of the tank rather than the more compact, thoroughly digested and less readily flowing sludge at the bottom. Great care must be taken not to draw all the digested sludge from the tank.

10. *USE OF PERFORATED PRESSURE PIPES.* If the sludge should not flow readily through any sludge removal pipe it may be loosened by forcing clarified sewage or water through the perforated pressure pipe in the bottom of the digestion chamber, provided the tank is furnished with this device. This device in our experience is not necessary and we do not advise its installation.

11. *REFILLING OF SLUDGE PIPES.* After each withdrawal of sludge the sludge pipe should be back-filled with water or clarified sewage to avoid formation of heavy deposits. If the latter is employed it may be pumped into the pipe by means of a force pump.

12. *DRYING OF SLUDGE.* The depth of sludge deposited upon the drying bed at any one time should not be over 6 or 8 inches. In dry weather the sludge should become spadeable in a few days and should be removed from the bed. It may be used as a fertilizer upon lands or it may be used for filling in low places upon which it is not anticipated that houses will ever be built. German experience indicates that such material is a fairly satisfactory fertilizer and is well worth hauling away and utilizing upon cultivated lands. It has the advantage of being able to lighten heavy soils and it would doubtless furnish humus to soils which are lacking in this feature. When deposited in fills the thoroughly digested sludge does not undergo putrefaction and will not cause any nuisance due to odors. Do not leave the dried sludge on the bed until it is time to remove more sludge, but remove it directly after drying.

13. *RE-SURFACING OF SLUDGE DRYING BED.* Whenever the surface layer of the sludge drying bed becomes clogged, the clogged material should be removed so that the minimum depth of sand shall not be less than 6 inches and sufficient new sand be applied. This feature is important in order that water draining from the sludge may be removed quickly, either by seepage into the underdrainage system or into the naturally porous subsurface materials, as the case may be.

14. *SAMPLING AND TESTING OF SEWAGE.* The superintendent of sewers or other official in charge of the sewage treatment and disposal works should be provided with Imhoff conical glass graduates for testing the amount of suspended matter in the raw and settled sewage. Composite samples, consisting of hourly samples of the day's run, should be collected of the sewage as it enters and leaves the tank. After shaking the samples well, two Imhoff glasses should be filled, one with the crude and the other with the settled sewage to the 1000 c.c. mark. After filling, the samples should be allowed to settle for a period of two hours, glasses being rotated every fifteen minutes to free particles which have become attached to the sides. At the end of the two hour period, the volume of settled material in each glass should be read and recorded to the nearest 0.1 cubic centimeter and the percentage of removal computed by dividing the difference between the number of c.c.'s of solids in the two glasses by the number of c.c.'s of solids in the glass containing the crude sewage. The results obtained should be noted in the proper space under *REMARKS* on the monthly operating sheets submitted to the State Department of Health. Ordinarily, this test should be run once each week. From these observations the efficiency of any installation may be roughly determined.

15. *MEASUREMENT OF SEWAGE.* Every installation should be provided with a measuring weir, suitable orifices or other devices for determining with reasonable accuracy the rate of flow of sewage.

16. *RESTING TANKS.* If there is more than one Imhoff tank at your plant and one tank is causing trouble through foaming, shut this tank off and allow it to rest. Before placing it again in operation see that the surface of the settling chamber is clear of floating material.

To follow these instructions a man must be at the plant every day. Neglect to follow Nos. 5, 6 and 9 may cause foaming in the gas vents. It may not take the entire time of one man for a small plant, but there is usually enough to do in the care of the grounds or the operation of the secondary units in the treatment to keep him busy. To work at all satisfactorily, much labor of an unpleasant character must be spent on the operation.

Most of the Imhoff tanks have good supervision, the operators being intelligent if not specially trained. A marked impovement in such supervision has been noticed since Chapter 23 of the Laws of 1918 was first enforced. The law now requires that all sewage operators be licensed by the State Department of Health.

The operators at Plainfield and Chatham are trained men with considerable experience in sewage treatment. At Pitman, Oaklyn, Hammonton, Fairview and Washington the engineers who designed the plants have general supervision over the operation. It therefore cannot be said in defense of the Imhoff tanks in New Jersey that they are neglected. An example of what happens to a well operated Imhoff tank when it is neglected was demonstrated in 1918 at the Chatham-Madison plant. When the operator was in the army, sufficient care was not given the plant. The tank ceased to function as a settling tank and the effluent was at times worse than the raw sewage. Belching took place continually in the settling compartment and the gas vents were filled with floating sludge and scum. A large amount of solids were carried into the contact beds which became badly clogged.

It has, however, been demonstrated in this state that a trained operator is not always necessary for the successful operation of Imhoff tanks. At Ventnor the operator is a foreigner with about the least technical training of any of the other operators, yet the operation of the tank has been most successful. The sewage, all of which is pumped, is very stale and contains much salt water. It has a dark appearance and is septic when it reaches the treatment plant. At times during the summer there is a rapid ebullition of gas in the vents, but no noticeable amount of scum has ever formed except in the early months of operation.

(To be continued)

Lawrence's Excellent Typhoid Record

One of the earliest practical results of the experiments of the Massachusetts State Board of Health in water purification was the construction of the sand filter at Lawrence, Mass. This filter was installed in 1891, and in a year or two the typhoid death rate was diminished by 60 per cent to 70 per cent. Lawrence is a manufacturing city, with a population at present of approximately 100,000, and before the installation of the filtration plant had had a very high death rate, due chiefly to the use of polluted water from the Merrimac river.

With the use of the filtration plant the typhoid

rate has been continually decreasing, until in 1921 there were only 20 cases and one death—much the lowest record yet attained and a remarkable one for a manufacturing city of that size.

In 1892, the first year after the installation of the filter, there were 172 cases and 53 deaths. The number of deaths decreased in successive years to 44, 28, 17 and 11, then rose three years later, in 1899, to 22. From 1899 to 1911 the number of deaths fluctuated between 10 to 21. Since 1911 the number of deaths has exceeded seven only twice, being nine in 1912 and ten in 1918.

This record is the more remarkable in that some of the filter beds are still uncovered (none of the original beds were built with covers) and this, in addition to involving an expense of removing ice from and scraping the open filters in winter, presents the danger of insufficient purification in the intense cold of that Northern city directly after the scraping and resurfacing of the sand.

Refuse Destructors and Disposal in Great Britain

By C. Chambers-Smith*

Description by the editor of one of the leading English engineering papers of the present status of refuse destructors in that country. Destructors are no longer being built and some of those already built are being abandoned.

A quarter of a century ago the opinion was general among sanitarians in Great Britain that the incineration of house refuse by destructors was the only efficient and sanitary method for the disposal of town refuse. A considerable number of cities and the larger municipalities erected destructors as a consequence. But these have, for various reasons, failed to maintain the early good opinions formed of their potentialities, amongst which reasons were the heavy cost of incineration, ranging from 3 shillings to 6 shillings 6 pence per ton, pre-war; the serious initial cost of an installation; the very general failure of destructors to obtain revenue by the sale of steam generated by the furnaces, to electricity and other works as was anticipated—for electrical departments deprecated their erection contiguous to their works, contending that the machinery would be likely to be injured by dust-laden air; whilst in those cases where steam was utilized it was deemed expedient to rely upon it only to assist the electricity works over the peak load, viz: about three hours per day, the steam generated during the remaining 21 hours being consequently wasted.

Another drawback was the failure to dispose of the clinker, which amounted to 33 per cent. to 40 per cent. of the original bulk of the refuse. In some instances the clinker was crushed and used for the manufacture of paving slabs for public footways, but the supply soon outran the demand, while the cost and quality did not compare with similar materials made by private firms which specialized in their manufacture. With the exception of the Borough of Hornsey, no city, to our knowledge, has been able profitably to use the whole of the clinker produced at its destructor works, and it has been necessary to cart or barge it away at a cost in London amounting in some cases to 10 shillings per ton. Then again, destructors or incinerators could not be operated without the creation of nuisances caused by fumes or alleged fumes from the chimney shafts, whilst the continual passage of vans loaded with refuse along streets adjacent to destructors constituted an objection to them in the eyes of owners and residents of inhabited property.

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DEMAND FOR DESTRUCTORS CEASING IN ENGLAND

It is chiefly owing to the objections thus defined that the demand for refuse destructors in Great Britain has almost ceased. For, in point of fact, the erection of a completely new installation has not been carried out for a number of years, whilst in numerous instances the operation of existing installations has ceased and the refuse is being disposed of otherwise, in some cases being barged to dumps in rural districts—a method, however, which is to be strongly deprecated as serious nuisances are caused thereby. In other cases the cost involved in the operation of destructors is now so excessive as to lead to their abolition, as was shown at a recent meeting in London of municipal engineers. The Borough Council of Hampstead has recently abolished their destructor and the engineers of the Borough of Hackney and the important urban district of Tottenham expressed their desire to see their destructors abolished.

IMPORTANT REPORT BY METROPOLITAN BOROUGH COUNCILS

The opinion expressed by a committee of representatives of Metropolitan Borough Councils and four borough engineers appointed to investigate as to the best means of disposal of refuse in the metropolis, who issued their report in December, also bears on the point. They remark that "municipalities have not adopted the destructor to any extent, indeed instances are know where, after heavy capital expenditure, this method of disposal has been abandoned; possibly owing to high cost of running, the large percentage of residual clinker, the inability to dispose commercially of the latter, and the difficulties in the way of successfully using the heat generated."

REFUSE UTILIZATION

These conditions have led a number of English authorities to investigate the possibilties of other means of refuse disposal. But it was left for the city corporation of Sheffield to take the initiative in showing other local authorities, as a consequence of experimental and research work, that town refuse contains material of considerable commercial value and that 35 per cent. of it is composed of cinders and small coal which have a calorific value equal to

that of ordinary coke. The corporation installed machinery for the purpose of separating the fuel from the general mass of refuse and of eliminating simultaneously the ashes and other fine constituents. They now use recovered fuel for direct steam raising at their public baths, whilst the surplus is briquetted with an admixture of coal tar pitch. The briquettes thus produced have a high calorific value and can be used for heating or steam raising. The revenue obtained from the separation of the various constituents of refuse, which comprise waste paper, scrap iron, bottles, rags, etc., runs into many thousands of pounds.

It must not be assumed, however, that Sheffield was the only authority which introduced "salvage methods" for, largely as a consequence of the exigencies of the war, nearly all the large towns in the kingdom undertook the sorting and salvage of house refuse, and derived considerable revenue therefrom; Edinburgh, for instance, obtaining £4073 in the year 1920-21 from salvage, whilst Glasgow obtained £6251 by the same process and other towns in similar ratio.

The Ministry of Health (London) in its last annual report comments very favorably on the advance made by local authorities in the utilization of house refuse and in the mechanical methods of separating from the refuse those materials which have an economic value. The Ministry also made reference to the crushing or pulverizing of the refuse—as is done in some districts—to fine powder for agricultural purposes, when it is inodorous, and the report of the Metropolitan Borough Committee to which we have already referred also approves of the method.

The Metropolitan Committee also indicates very clearly in their report that the sorting of refuse by specially designed machinery is, in their opinion, the best means of refuse disposal and that the great bulk of refuse can be converted into marketable commodities and sold in relief of rates.

HIGH TEMPERATURE INCINERATORS NOT A SUCCESS

It needs to be explicitly reiterated that the high temperature incineration of municipal or house refuse in Great Britain is not a success, that numerous authorities which adopted destructors have closed them down owing to the serious cost involved in their upkeep; that contemplated revenue from steam from destructor furnaces and from clinker has not been obtained. Moreover, no new destructor installations have been erected in Great Britain for a number of years past. Some form of furnace, probably of one or two cells, will, however, probably be required for the incineration of infected or filthy bedding and of infected carcasses, though the improved machinery for reducing organic waste is now very efficient and, where the quantities are sufficient, local authorities can produce high class fertilizers from condemned meat, fish, etc. Such plants are in operation at Stoke-on-Trent, Sheffield, Birmingham, Blackpool, Bradford, and many other places.

New London Turnpike—III

Distribution of materials. Obtaining and distributing water. Mixing the concrete. Equipment used.

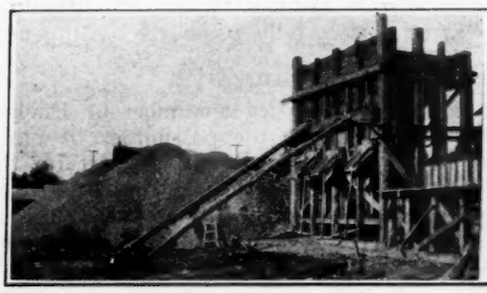
The construction of the 33½ miles of road was divided into four nearly equal contracts, numbered from the north southward 1, 2, 3 and 4, which were operated simultaneously with independent supplies and equipment except that some of the stone and sand were furnished to more than one contract from the same source. For contract No. 1 there was established at the north end, at Glastonbury, a freight station and a 12-car cement storage shed. The stone and sand received in railroad dump cars, were hauled up an incline and dumped from a considerable height into storage piles from which hopper-bottom loading bins, filled with a clamshell bucket, delivered to trucks that distributed the sand and stone alongside the road on the subgrade. Cement was delivered in trucks and stored in piles about 45 feet apart, five of which were always maintained in advance of the mixer. The bags were piled on elevated platforms and covered by tarpaulins so that no injury was sustained by the cement in wet weather.

DISTRIBUTION OF MATERIALS

The stone for the northern half of contract 1 was delivered at the freight yard in Glastonbury in side-dump standard-gage cars, hauled over the trolley tracks, and to the top of the trestle, whence it was dumped to a 1,500-yard storage pile and later transferred by a crane and clamshell bucket to the 10-yard elevated loading hopper. The hopper, gate and chute delivered the stone into five one-batch compartments in the bodies of 5-ton automobile trucks, which transported it to the mixer.

Cement was stored in a 12-car shed at Glastonbury and was at first added to the broken stone in

Part I—Grading, unloading and storing aggregate and cost of handling stone published in January 14th issue.
Part II—Quarries, sand pits, distribution of cement and aggregate, storage bins, pumping, mixing and finishing in January 21st issue.



50-YARD STONE LOADING BIN AT COLCHESTER

STORING BROKEN STONE ON SUBGRADE

HAULING BROKEN STONE TO SUBGRADE STORAGE

the batch compartment of the trucks, but it was found that this made the load too heavy to be transported without injurying the subgrade, and afterwards the cement was hauled separately, reducing the load of the 5-ton trucks sufficiently to enable them to traverse the subgrade without injury. The bags of cement were piled on elevated platforms about 45 feet apart, covered with tarpaulins to protect them from the weather, and always maintained in advance of the mixer.

The sand for this section was excavated from a local pit alongside the road by a derrick and clamshell bucket and delivered to the mixer by trucks and teams with a maximum haul of about 2 miles. The sand was so clean, sharp and well graded that it did not require screening nor washing and passed a test of 120 Ottawa.

For the southern half of section 1 the broken stone was delivered by trucks from the Marlborough quarry with an average haul of 2 miles and a maximum haul of 4 miles. Sand was excavated from pits near the middle of the section and hauled by trucks to the mixer with only a short detour. Cement was hauled by trucks from Glastonbury a maximum distance varying from 4 to 6 miles. Cement from the 12-car storage shed at Easthampton was delivered to the mixer in trucks hauled 6 miles over a poor road and then an average distance of 2 miles over the subgrade.

The north half of contract 2 was supplied with cement from the freight yard at Westchester, with broken stone from Marlborough quarry and with local sand hauled in trucks and stone supplied by the New Haven Trap Rock Co., all hauled to the mixer by trucks. The south half of section 2 was similarly supplied from storage at Colchester.

Contract 3 was supplied with broken stone, sand and cement hauled from the freight yard by industrial trains in Colchester, and contract No. 4 was supplied with cement and aggregate, hauled by industrial trains from the New London yards and quarry. The sand for this contract was delivered into bins by derrick and loaded from elevated hoppers to the trains. Cement was also delivered by water at New London and stored in large quantities there.

The concrete mixers working south from Colchester on contract No. 3 and north from New London on contract No. 4 eventually met at Salem, where the two contracts joined, and were supplied with material delivered in 18 steel batch boxes hauled in each by four 9-car trains drawn by Whitcomb or Burton gasoline locomotives.

CLETRAC TRACTOR HAULING 3½-YARD SAND TRUCK 1,000 FEET AROUND SECTION OF NEW CONCRETE PAVEMENT AT COLCHESTER

The cars were filled conveniently through gates at the bottom of the loading hopper and were operated in 9-car trains except where the grade was so heavy that only 5 cars could be hauled. The length of the industrial tracks was limited by the length of time required for hauling, when the latter became so great as to delay the mixer. This required shifting the bins about every 10,000 feet and it was found less expensive to haul the aggregate and cement in trucks driven over the new road as far as the concrete was hard enough to endure traffic, a distance usually about 8 days behind the concrete mixer, and there dumped it on the concrete surface to be shoveled by hand into the industrial cars on the 24-inch track laid on the shoulder alongside, that delivered it directly to the skip of the mixing machine. By this method two 9-car trains with an average haul of about 4,000 feet were able to serve each mixer.

On contracts 1 and 2, where the materials were hauled over the subgrade, it was sometimes necessary in soft spots to assist the trucks with the cletrac tractor.

WATER SUPPLY

As the road was located entirely through rural districts possessing no water system, it was necessary for the contractor to supply his own water for the boilers, concrete machines, curing and other purposes and it was obtained wherever most convenient from creeks and ponds and delivered directly to the mixer through pumps that were shifted from time to time to nearer supplies as the length of the discharge pipe became longer and longer. For this service the contractor laid and relaid about 17 miles of 2-inch, 2½-inch and 3-inch pipe in sections up to a maximum length of 3 miles. An abundant supply of water was necessary to avoid possibility of interruption and to serve the steam shovels and boilers installed for the distribution work. There were therefore used six gasoline pumps, four single-cylinder driven pumps, and three duplex steam pumps, the last being found most satisfactory. The steam pumps were considered preferable to gasoline pumps on account of their greater reliability.

MIXING AND PLACING CONCRETE

The concrete was deposited between Blaw-Knox steel forms of which about 5,000 linear feet were provided. These were maintained about 500 feet in advance of the mixer and the subgrade was prepared from 300 to 400 feet ahead of the mixer at all times in accordance with the engineer's requirements.

The concrete was mixed with five chain-belt Rex mixers, three of them of 3-bag capacity being installed in April 1921, one 5-bag capacity August 1st, and another of 2-bag capacity being used to expedite the work for a few weeks.

The 5-bag mixer was loaded by trucks with end dumps, discharging directly into it and was operated by a twenty-man gang, consisting of five pavers, three finishers, two machine men, two cement men, four

sand men, and four dumping men. This machine laid from 565 to 600 linear feet of pavement daily.

The 3-bag machine supplied with materials delivered in batch boxes by the industrial cars was operated by eight men paving and finishing, four men dumping batch boxes into the hopper, and two men on the machine, making a total of fourteen men, although it was found necessary to keep an eight or ten man gang busy ahead of the mixer to do the fine grading after the shovel crew had prepared the subgrade as well as they could.

On contract 2, where the stone and sand were delivered in piles on subgrade and aggregate and cement were brough to the machine in wheelbarrows, a gang of thirty-three men was necessary and consisted of operator, fireman, four spaders, three finishers, and twenty-four wheelbarrow men, together making a progress of about 400 linear feet per day.

The finishing for one of the machines was done by hand and for the other three large machines was done by Lakewood machines which were found very satisfactory to follow up rapid mixing and produced better concrete by the thorough tamping, which prevented the honeycomb formation around the edges of the pavement. The inspectors were very rigid in exacting a mixing period of 90 seconds, actually determined with a watch, and the proportion of water was fixed by a gaged tank. Concrete specimens were taken for testing by the inspectors. Expansions joints made with 1-ply tar paper folded eight times were placed 35 feet apart. They were not, however, necessarily located at the termination of a day's work.

FORCE AND EQUIPMENT

The maximum force employed was about 700 men, who received from 30 to 35 cents per hour for labor, 45 cents for pump men and from 50 to 55 cents for engine men and machine runners. Most of the men were accommodated in ten camps maintained about two miles apart by the contractor. These camps consisted of groups of ten-man wooden bunk houses made with 8 x 12 foot detachable wall panels and two-section roofs that were quickly assembled and taken down.

The work was executed under the direction of fifteen state inspectors, one of them being stationed at every concrete mixer, one at every rock cut, one in every grading gang and one with every shoulder gang.

The principal equipment installed on the job, including that already mentioned, comprised four Ingersoll-Rand portable air compressors, six portable boilers, four ½-yard to 1-yard clamshell buckets, five chain belt Rex concrete mixers, eight derricks with Lidgerwood and Mundy steam hoisting engines, three Lakewood finishing machines, two Brown hoist locomotive cranes, one Pawling and Harnischfeger gasoline crane, one Browning crane, one Haiss and one Barber-Gren bucket loader, seven Cameron-Deane and Novo steam pumps, six gasoline pumps, twelve Ingersoll-Rand jackhammer drills, 16 Ingersoll-Rand tripod drills, two Farrel stone crushers, two Good Roads Machinery stone elevator and screening outfits, one Champion sand washing machine, one Good Roads scraper, four Buffalo-Pitts rollers, one 3-trac Tractor, three Erie and three Marion steam shovels, one saw rig, four road machines, 10,000 linear feet of industrial track, sixty industrial cars, one hundred Lakewood steel batch boxes, three Burton and three Whitcomb gasoline locomotives, four wooden hopper bottom storage bins of 10 to 40 yards capacity, one portable steel storage bin of 20 yards capacity, 10,000 linear feet of Blaw-Knox forms, fifty 12 x 20-foot standard portable camp houses, about seventy-five two-horse bottom dump wagons and forty five-ton trucks, mostly of the Mack and Pierce Arrow type, all of which were hired The trucks when running on subgrade were only able to travel about 40 miles per day, but under good conditions when running on the finished concrete road traveled up to 125 miles per day. They were kept in repair by the sub-contractors and very little delay was occasioned by breakdowns, the source of troubles occasionally encountered being usually with the hoist, most of which were of the oil cylinder and cable dump type.

During the hot weather the engineers required the concrete for 75 feet in the rear of the mixer to be protected with canvas screens on wooden frames that shielded it from the hot sun and until it had taken initial set. This protection was not required during the spring and fall, but late in the fall the fresh concrete was covered wth hay. From May 1st until September 25th the concrete was covered the second day with 2 inches of earth thrown in from the sides of the road and kept saturated for eight days.

Activated Sludge Experiments

According to a report by the U. S. Public Health Service, in its "Engineering Abstracts," in Sheffield, England, activated sludge experiments have been conducted since 1920 in a large tank so divided as to provide a continuous channel 3,544 feet long, in which circulation and activation are obtained by 18 paddle wheels, 600,000 gallons of strong sewage being treated daily. The effluent is settled in Dortmund tanks. Experiments in dewatering sludge have included the application of a vacuum to the sludge in a film on a travelling gauge band, reducing the moisture from 98 per cent. to 75 per cent. and drying on a revolving drum which dips in the sludge.

THREE-BAG PAVER SERVED BY WHEELBARROWS AT POINT THREE MILES NORTH OF COLCHESTER

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Refuse Disposal by High-Temperature Furnaces

There are few, if any, who would question the statement that the most sanitary and least offensive way of disposing of garbage and most other combustible refuse is by burning in high-temperature furnaces. There are, of course, cheaper methods, such as dumping or burying on vacant land; and to offset this disadvantage of expense the creation of steam and vitrified clinker in so-called destructors has been advocated, these by-products to be sold or utilized to advantage.

In advocating destructors for United States cities reference has commonly been made to the English practice, destructors being reported to be located in the midst of built-up sections of the cities of that country without objection and to return considerable net profit to municipalities over and above all costs of operation, this profit being derived from the sale of crushed clinker for use in concrete and for other purposes, and the sale of steam or profitable use of it by other municipal plants.

As to the last, PUBLIC WORKS has on several occasions mentioned the fact that not more than one or two destructors in this country were using steam or clinker to an extent sufficient to return a net profit, and we believe that none are doing so now; in fact, most of them do not realize sufficient to pay interest and depreciation on the amount by which the cost of a destructor plant exceeds that of one designed for complete incineration only.

Recently reports have come from England that the same has been found true of many of the destructors in that country. In order to ascertain the real condition as to this we have requested Mr. C. Chambers-Smith to give us a description of the situation at present, and this description is presented in this issue. The author is the editor of "Municipal Engineering and the Sanitary Record," probably the leading English paper devoted to municipal public works; he is a member of the "Institute of Municipal and County Engineers" and a Fellow of the "Royal Sanitary Institute," and is, we believe, fully competent to give an accurate and unbiased statement concerning the present status of refuse disposal in Great Britain. We recommend a careful reading of his article by all who are interested in this subject.

Water Users vs. Taxpayers

Is it legal, and if legal is it good business or justice to the water users, to use the surplus income of a municipal water department for helping to lower the rate of a city? As noted in last week's issue, it is reported that one of the large cities purposes to increase its water rates so as to yield a surplus and transfer this surplus monthly to the general fund of the city, if it can legally do so.

The legal right will generally depend on the state laws, city charter, etc., and must probably be decided separately for each case. But, while there may be exceptions, the decision as to whether it is good business or just to the water user would seem to be of general application.

One of the greatest difficulties in connection with the municipal operation of public utilities is securing economy in operation, and anything that stimulates a desire among municipal employes to secure more economical administration of a department should be encouraged. But what inducement is there for officials of a water department to economize if they know that any saving so effected is to be used, not for the benefit of their department but for purposes entirely disconnected therewith—possibly to permit waste in another department? It would be only human nature for those in charge of the water department to try to keep all of its income in the department. Certainly there is no inducement for economy.

As to justice, it hardly seems to us right to compel the water users to pay for other classes of city expenditures in proportion, not to the benefit they derive from such expenditures but rather to the amount of water they use. It is sometimes argued that the taxpayers and water users are the same individuals and it makes little difference whether the amount they pay for running the city is called taxes or water rent. But taxes are supposed to be based on property valuation, and if part of the water rental goes to increase the tax fund and thus is practically a tax, this tax is assessed, not on the basis of property but on that of water consumption. The scheme should rejoice the heart of the large property owner, for he thus shifts a part of his tax onto the water users of the city.

One or two cities of the country go to the other

extreme and give water "free," paying all expenses of the water department from the general taxes. This encourages waste by the consumer, but at least it favors the small property owner and compels the large owner to pay for a part of his water service, instead of favoring the more wealthy owners at the expense of the general water consumers as does the other plan.

Good Season's Record in Highway Work in Kansas

By A. A. Anderson*

Paving twenty-three miles of sixteen-foot concrete road in one season at an average rate of a thousand feet a day with two mixers, reaching a maximum rate of 846 feet with one mixer. Description of methods and plant

That portion of the Santa Fe trail located in Finney County, Kansas, and extending across the county, a distance of twenty-eight miles, is being paved with a sixteen-foot concrete surface. This work is known as Kansas Federal Aid Project No. 22.

The road follows the old route of the trail, with some modification in sharp curves and reduction of grades, passing through a flat table land and an extensively irrigated section along the Arkansas river bottom. The maximum grade is 5.7 for one short section. The sharpest curve is a 200 feet radius, on which the pavement is widened to twenty feet and superelevated ten and one-half inches. The typical cross-section is a sixteen-foot concrete roadway with six-foot earth shoulders. It has a two-to-one slope from shoulder to ditch, a two-foot ditch, and one and one-half to one on the back slopes. The maximum cut is about five feet and the maximum fill the same.

*Division Engineer, Kansas Highway Commission.

The drainage is effected entirely by open earth side ditches and by reinforced concrete box culverts from 2 ft. x 2 ft. to 4 ft. x 6 ft. in cross-section, by 18 to 24-inch corrugated metal side-road or entrance culverts with concrete headwalls, and by sumps consisting of concrete catch basins and perforated casings extending to the underflow of the Arkansas river basin. Numerous irrigation ditches are carried under the pavement by means of inverted syphons except in one case of a large ditch where the grade was raised and pavement carried over by a forty-foot reinforced concrete deck girder.

The concrete slab is of plain concrete, 6 inches thick on the sides and 7¾ inches in the center, of which the east eighteen miles is of one-course construction and the remainder of two-course construction. The old roadway was ninety per cent. ordinary earth and ten per cent. sand-clay surface. The character of the soil is such that the pavement can be

PUMP ON BARGE OBTAINING GRAVEL FROM RIVER BED AND DELIVERING IT TO SCREENING AND WASHING PLANT

laid direct on subgrade without any foundation course.

The concrete in the one-course construction is proportioned 1:2:3¼ of Portland cement, clean pit sand and gravel, screened from the Arkansas river and pits. The two-course construction is 1:1½:2½ top course, with same coarse aggregate as for the one-course except for grading, and a pit-run aggregate base. The proportion for the base course is determined by the per cent. of pit run aggregate retained on a one-fourth inch screen and varies from 1:3¾ to 1:5 of Portland cement and total volume pit run material. This produces a base of nearly uniform strength which will test not less than eighteen hundred pounds per square inch on twenty-eight day test.

The entire project was let with proposals for grading, culverts and pavement separately, or combined bids on grading and culverts, or total bid. Bids were opened on June fifteenth and July twenty-third, 1920, and the contract awarded to M. R. Amerman Paving Company of Wichita, Kansas and A. L. Cook of Ottawa, Kansas, for a total sum of $1,106,040 on unit price basis. The actual construction was commenced on the east eighteen miles in August, 1920, and the remaining ten miles in August, 1921. At the close of 1920 construction season, a large part of the grading and culvert work had been completed and a test run of 4,704 feet of pavement laid to ascertain weak points in organization and equipment layout. Active construction in 1921 was commenced on April fifth, 1921, and at the close of 1921 construction season on October fifteenth, 23.5 miles of pavement slab had been completed. The portion of the slab built during 1921 was 22.6 miles in length, of which 5.2 miles was of two-course construction.

GRADING

The grading is carried on by the two organizations, one of which consists of about forty head of stock and ten men, using an elevating grader and fresno outfit; the second consisting of about thirty head of stock, and ten men, using two-horse Mayney wheelers, snatched by a tractor. The earth is brought in from side ditches and cuts and placed in one-foot layers. It is thoroughly rolled with a 10-ton three-wheeled Case steam roller.

Fine grading is carried from one-half to one mile ahead of the mixer with a blade grader and slips, using an organization of about ten head of stock, ten men and a foreman. Upon this grade metal forms are set to true grade and alignment, and carried about four hundred feet ahead of mixer by two form setters and a helper. A total of about three thousand lineal feet of Blaw forms are used for each mixer. At the close of the work at noon and night, a Carr subgrader supported by the forms and drawn by 10-ton roller is used for leveling and smoothing the subgrade to exact grade for receiving the pavement slab.

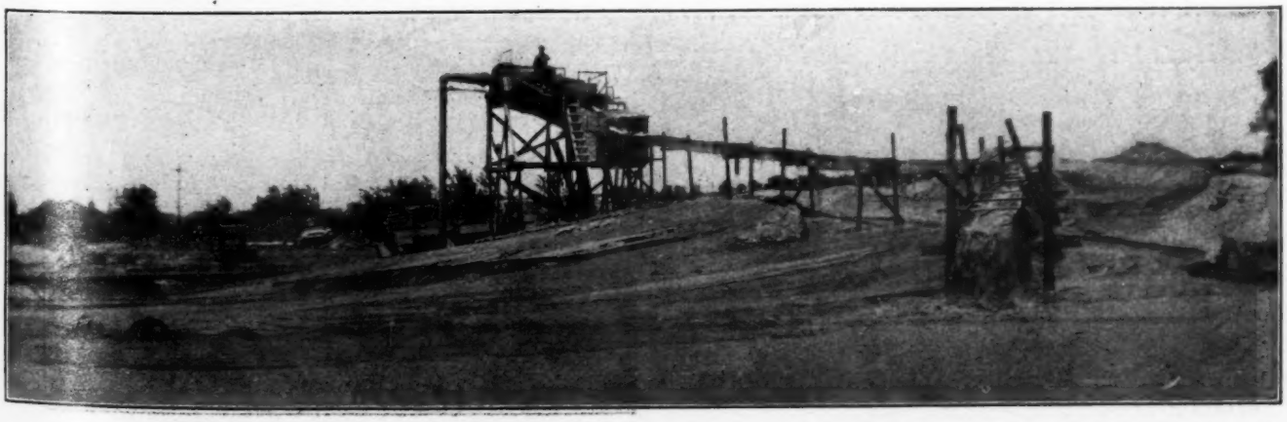
SUPPLY OF MATERIALS

All aggregate for the pavement slab is secured locally, cement being the only material involving rail haul. A bank-run material is secured from the Arkansas river bed, screened and separated on a ¼ inch screen and reproportioned.

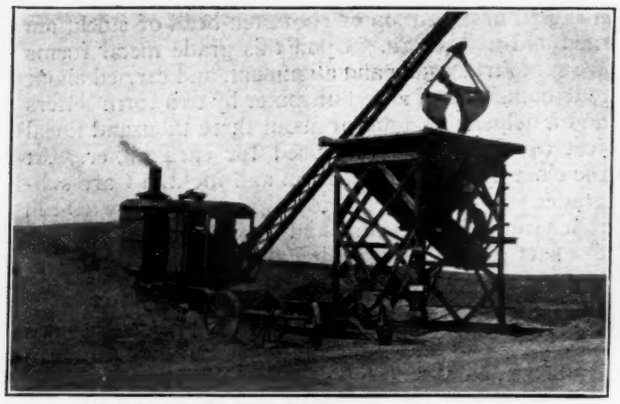
At first it was thought possible to secure sufficient coarse aggregate by screening all material from the river channel, using pumps. Two barges were rigged, using an eight-inch Amsco and a ten-inch Erie pump respectively, each pump belt driven by a 100 h. p. squirrel cage induction motor, using a 42-foot suction and an average of 120-foot discharge line. The pump discharged into a 10-foot rotary screen, motor driven, having about seven feet of ¼-inch mesh screen and three feet of 2-inch screen.

The material passing the ¼-inch screen with the water was flumed back to the river, sufficient sand being trapped in the flume, producing a stock pile of sand along its entire length. The material retained on the ¼-inch screen and passing a 2-inch screen was dumped into trucks ready for delivery or diverted to stock pile, while all material over 2-inch size, together with mud balls, was rejected at end of screen to a separate pile. The pit-run material as pumped contained about twenty-five per cent. of material over a ¼ inch size and limited the production of each outfit to thirty cubic yards coarse aggregate per eight-hour day. This total coarse aggregate produced, amounting to one hundred twenty cubic yards for both outfits, running sixteen hours, was sufficient to supply only one mixer.

The material supply being insufficient, upon investigation numerous dry pits were located away from the immediate stream bed. From these pits it was possible to produce fifty cubic yards per eight hour day per pit, using a gravity screen under a trap and six teams. The material in these pits furnished



ROTARY SCREEN AND FLUME PREPARING AGGREGATE PUMPED FROM RIVER BED



CRANE LOADING MOVABLE BIN FROM STOCK PILE

from thirty-five to fifty per cent. of material over a ¼-inch and under a 2-inch size.

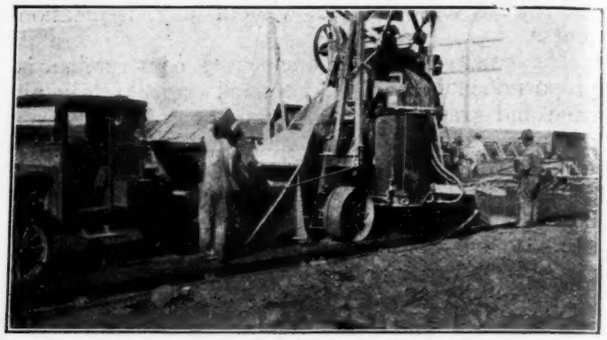
These two methods produced sufficient coarse and fine aggregate during the winter of 1920. It was delivered to stock piles on the road, involving a haul of from two to eight miles at the following approximate costs per cubic yard; sand, $3,00; coarse aggregate from dry pit, $4.50; from river plant, $4.00.

STORING AND TRANSPORTATION OF AGGREGATE AND CEMENT

The fine and coarse aggregate are hauled to stock piles and placed in separate piles at points of advantage on the road at an average distance of one mile apart. This hauling is done by the contractor's trucks and by local teamsters and truckmen on contract basis per yard mile. The sand and coarse aggregate are piled at such distance apart that both piles can be conveniently handled to a movable bin with two compartments by an Erie crane with a 32-foot boom and a ¾ yard clam shell bucket. The crane handles from three hundred to three hundred fifty cubic yards of aggregate per day. The stock piles were placed a mile apart on seventeen miles of the road, and every half mile on the balance, using a twenty-yard portable hopper. The material is loaded into the bin with a small Erie crane.

The cement is delivered to stock piles a reasonable time before using and piled on platforms and covered with tarpaulins. About fifteen hundred to two thousand sacks of cement is used per day per mixer.

The hopper of the movable bin is divided proportional to aggregate used in mix. Each compartment discharges into a separate inclined measuring box calibrated to produce the exact amount of coarse and fine aggregate for one batch. The measuring box has sufficient clearance for a truck with a one-batch body. The material is discharged into the truck body thru an end door hinged at the top.



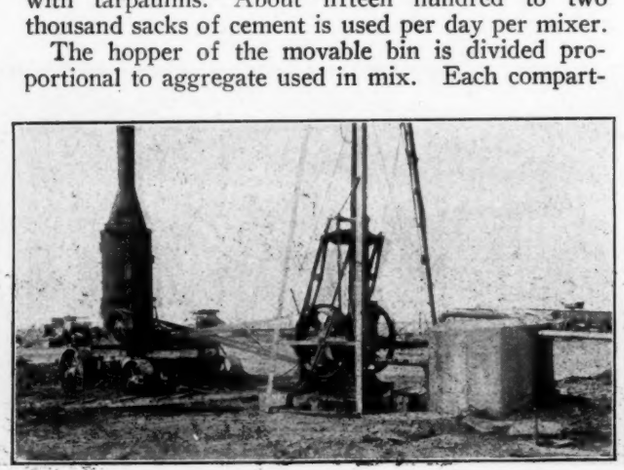
HOME-MADE TRUCK BODIES DUMPING INTO KOEHRING PAVER

The whole operation of filling and dumping the measuring boxes takes about ten seconds, after which the truck is driven to the cement pile not over two hundred feet distant, where five sacks of cement are quickly emptied on the aggregate and the truck proceeds directly to the mixer. A total of not over one minute's time is required for the entire loading operation at plant. The organization at the stock pile consists of one craneman, one crane foreman, one bin man, five men handling cement, one general utility man and one man and team keeping material piles cleaned up and in reach of the crane.

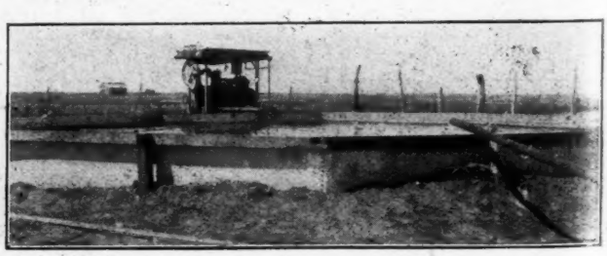
An average of ten small trucks are ample to supply one mixer from stock pile. These trucks are of one-half ton class, pneumatic tire equipped, a single home-made frame batch box of about 25 cubic feet capacity is mounted on the truck. These boxes are hinged at the end of the car frame and in such position that the batch box can be easily dumped. The end gate of the batch boxes is attached rigidly to the frame in place so that materials have free access to come out when the box is dumped. On an average haul of one-half mile, about thirty-two batches are hauled per truck per day or an average of fifteen minutes for the entire trip.

WATER SUPPLY

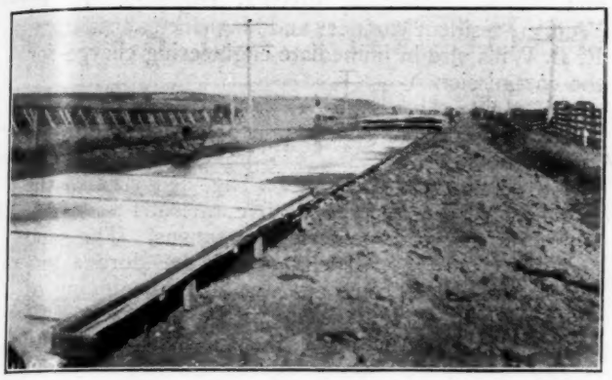
In the Askansas river bottom, ample water is secured from wells twenty feet deep. Six to ten-inch well casings were driven and a four-cylinder C. H. & E. triplex pump with a 2-inch suction line supplied one of the mixers and a one-cylinder, 7½ horse power C. H. & E. triplex pump with a 2-inch suction line supplied the second mixer. One extra one-



DEEP-WELL WORKING HEAD, PUMPING FROM A DEPTH OF 120 FEET



RESERVOIR USED IN CONNECTION WITH DEEP-WELL PUMPS



FINISHED PAVEMENT COVERED BY SUN SHADES IN FOREGROUND AND BEING SPRAYED BEYOND THESE

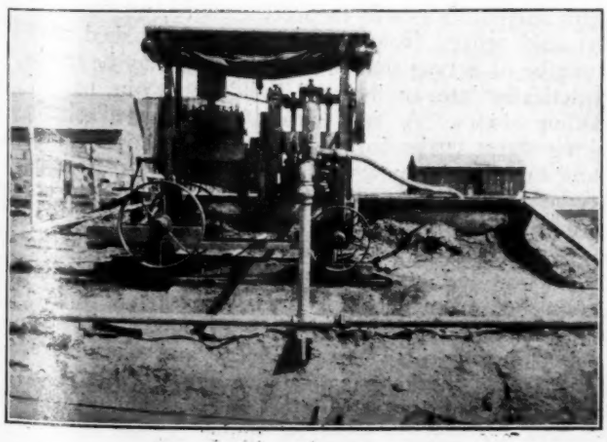
cylinder C. H. & E. triplex is kept placed on the job for emergency. A total of seven miles of 2-inch line is used to supply both mixers, water being pumped at times as far as 3½ miles.

In the hills or on high table land it was necessary to drill wells 120 feet deep. A steam driven C. H. & E. working head with a 3x36 in. cylinder, discharged thirty gallons per minute into a 15,000 gallon reservoir or supply tank, from which it was pumped to mixer with usual equipment. By pumping continually twenty-four hours, thus having full reservoir at beginning of a day's work, adequate supply was obtained for mixer and ponding.

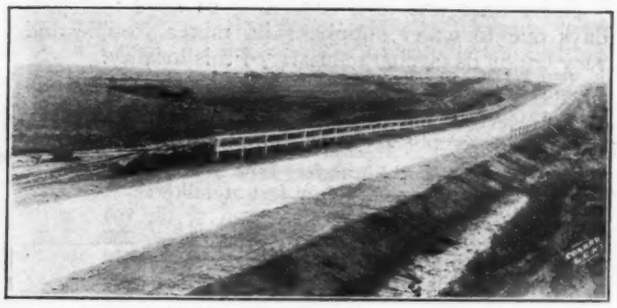
The tanks used in storing water were made in an octagonal shape using full sheets of sheet metal 16 gauge, backed up with 4x4's; that is, the 4x4's were nailed around the top of the tank, with a post at each joint, using "Arco Sealit" to seal the joints of the sheet metal. A concrete floor was laid in the bottom of the tank, out of waste cement obtained by the sack cleaner, made just thick enough to be water tight. The tanks cost about $75 each, and were easily and quickly set up.

CONCRETING

One of the mixers was a Rex 21 E paver and the other a Koehring 21 E paver. The concrete deposited on subgrade is spread by three shovelers. It is struck off, tamped and belted by means of a Lakewood finishing machine, going over the surface not



FOUR-CYCLE TRIPLEX PUMP PUMPING WATER THREE MILES



SECTION OF COMPLETED ROAD

less than three times. The final touch is given by a hand belt operated some distance back of the finishing machine. Immediately back of the finishing, the concrete is protected by canvas covers on framework supported by the forms. When the concrete is hardened sufficiently (generally about one-half day behind the mixer), dams are thrown across and along the edge of pavement and the surface ponded.

Considerable difficulty was encountered with hair checks, especially on the windy days. Wetting the sunshades or canvas laid directly on the surface was found ineffective for preventing these hair checks. This trouble is entirely eliminated by judiciously using a fine spray of water from a hose nozzle in such a manner as to produce a heavy mist, keeping the surface moist until such time as the ponding can be carried forward.

The concrete gang includes a foreman, two truck dumpers, a mixer man, three men grading concrete, one man operating the finishing machine, one finisher and helper, one man on subgrade, two on the pumps, four ponding, four night pumpers and ponding, three men at the steam crane and bin, four at the cement storage pile, and one man sprinkling the pavement and for general utility.

PROGRESS

The progress per mixer working day was five hundred linear feet of pavement, averaging the 243 mixer working days of the 1921 construction season. A mixer day is any day in which the mixer was started, even though it was not operated the full day.

REX PAVER IN OPERATION

Some time was lost, consisting of days and part days due to water supply, rain, mixer trouble and very windy days, characteristic of this locality.

The log for period runs and the best day's run for each mixer during the 1921 season was as follows:

MIXER NO. 1

Best day's run—772 linear feet June 14th, 1921.
Best 5 days' run—3,472 linear feet as follows:

July	7th	700
"	8th	732
"	9th	668
"	11th	746
"	12th	626

Best 20 days' run—12,770 linear feet as follows:

July	6th half day	242
"	7th	700
"	8th	732
"	9th	668
"	11th	747
"	12th	626
"	13th	612
"	14th	549
"	16th	764
"	18th	691
"	19th	758
"	20th	700
"	21st	550
"	22nd	727
"	23rd	559
"	26th	585
"	27th	515
"	28th	695
"	29th	753
"	30th	608

MIXER NO. 2

Best day's run—846 linear feet, June 14th, 1921.
Best 5 days' run—3,414 linear feet as follows:

June	13th	670
"	14th	818
"	15th	575
"	16th	753
"	17th	598

Best 20 days' run—11,655 linear feet as follows:

Aug.	1st	551
"	3rd	456
"	4th	676
"	5th	733
"	6th	720
"	8th	637
"	9th	520
"	11th	530
"	12th	660
"	13th	710
"	15th	708
"	16th	710
"	17th	248†
"	22nd	289†
"	23rd	584
"	24th	568*
"	26th	659*
"	27th	608
"	29th	508*
"	30th	572*

†Water trouble.
*Square yards on curves reduced to equivalent lineal feet of sixteen-foot pavement for comparison.

PRINCIPAL QUANTITIES

The estimated quantities involved include about 149,687 cubic yards of earth excavation, 27,038 cubic yards earth borrow, 943.5 cubic yards Class A concrete, 197.8 Class C concrete, 198,136 square yards plain cement concrete pavement.

The construction is carried out by L. S. McCaslin, superintendent for M. R. Amerman Construction Company and is supervised by the Kansas Highway Commission, M. W. Watson, state highway engineer, and A. A. Anderson, division engineer. E. C. Wenger, resident engineer and his principal assistant, R. B. Wills, are in immediate engineering charge for the commission.

Mr. McCaslin has given us the following additional information:

The cement costs 80 cents a bag, delivered to the storehouse. An average of five carloads was kept stored on the road, protected by canvas. The sand and gravel cost $4.50 delivered to the storage bin. Labor received 50 cents an hour at the beginning of the work and 40 cents later; mechanics received 75 cents. The contractor used ten Panhard 1½-ton trucks and tried twenty others of miscellaneous makes.

The gravel was crushed with a Gates gyratory crusher. The screen used was made by the Road Supply & Metal Co. of Topeka. The portable loading hopper was mounted on wheels when moving, on skids when in use, the wheels being removed and replaced by the aid of the crane. Two hours were consumed in replacing wheels, moving, and putting back on skids.

Eight shallow wells were driven by the contractor by means of a sand bucket, and 6-inch casing used, the cost being about $1.00 a foot. A C. H. & E. deep well working head with 3-inch drop pipe was used for pumping the deep wells.

Benefits of Public Markets

The Department of Agriculture has recently issued a bulletin entitled "Open Types of Public Markets," which discusses the function of public markets, their ownership and control, establishment and operation, and which may be had free by writing to the Department of Agriculture at Washington. In general the bulletin expresses the opinion that:

"Open retail markets constitute the simplest and least expensively operated of all types of public markets. In its simplest form a market of this type may be merely a designated length of curb, a section of a broad street, or a vacant lot, where, under slight supervision, farmers may group their wagons and sell to consumers.

"In its highest development such a market may consist of a paved tract with raised walks covered with substantial sheds to protect teams, wares, buyers and sellers from the weather. The shed may even be of a type that in bad weather may be made practically into an inclosed building by the use of rolling doors. A few cities have erected sheds along street curbs for the protection of open markets, but for the most part curb markets are unprotected and sheds are constructed only in markets situated on special market tracts.

"The essential feature of a retail market is the restriction of purchases to consumers as distinguished from dealers. Such a market, if it is a "producers' market," furnishes an opportunity for direct dealing between producers and consumers. Open retail markets may also admit hucksters, or wagon and push-cart peddlers as salesmen. These dealers are usually admitted under certain restrictions."

NEWS OF THE SOCIETIES

CALENDAR

Jan. 30 — NEW JERSEY STATE LEAGUE OF MUNICIPALITIES. Annual meeting. Trenton, N. J.

Jan. 30—SOCIETY OF AMERICAN MILITARY ENGINEERS. Washington, D. C.

Jan. 30-Feb. 1—NATIONAL CIVIC FEDERATION. 22d annual meeting. Hotel Astor, N. Y. C.

Jan. 31—NEW BRITAIN BRANCH, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary—R. W. Sellew, Fafnir Bearing Co., New Britain.

Jan. 31 — PROVIDENCE SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Narragansett Hotel.

Jan. 31-Feb. 1—LEXINGTON REGIONAL HIGHWAY CONFERENCE. University of Kentucky, Lexington, Ky.

Feb. 4-11—ST. PAUL BUILDING EXCHANGE EXPOSITION. St. Paul, Minn.

Feb. 12-17 — CONFERENCE OF HIGHWAY ENGINEERING, 8th annual conference. University of Michigan, Ann Arbor, Mich.

Feb. 13-16—AMERICAN CONCRETE INSTITUTE. Annual Convention, Cleveland. Secretary, Harvey Whipple, 814 New Telegraph Bldg., Detroit, Mich.

Feb. 14—ENGINEERING SOCIETY OF BUFFALO. Iroquois Hotel, Buffalo. Secretary—N. L. Nussbaumer, 80 W. Genessee St., Buffalo.

Feb. 15-17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Tenth midwinter convention. Engineering Societies' Bldg., New York City.

Feb. 21-22 — KENTUCKY ASSOCIATION OF HIGHWAY CONTRACTORS. Annual meeting. Louisville. Secretary, D. R. Lyman, 523 Court Place, Louisville, Ky.

Feb. 21-23 — MINNESOTA FEDERATION OF ARCHITECTS AND THE MINNESOTA SOCIETY OF CIVIL ENGINEERS. First annual convention, Curtis Hotel, Minneapolis.

Feb. 22—AMERICAN ASSOCIATION OF ENGINEERS. Conference of practicing engineers. Congress Hotel, Chicago.

Feb. 22—AMERICAN BUILDING EXPOSITION. Municipal Auditorium, Cleveland, Ohio.

Apr. 19-21 — TRI-STATE WATER AND LIGHT ASSOCIATION OF THE CAROLINAS AND GEORGIA. Spartansburg, S. C.

Apr. 27-30—BUILDING OFFICIALS' CONFERENCE. Apr. 27-28, Cleveland, O.; Apr. 29, Massillon, O.; April. 30, Youngstown, O.

May 15-19 — AMERICAN WATERWORKS ASSOCIATION. Annual convention. Philadelphia, Pa.

AMERICAN SOCIETY OF CIVIL ENGINEERS

The sixty-ninth annual meeting was held January 18, 19 and 20.

At the business meeting, January 18, honorary membership was conferred on: M. Charles Prosper Eugene Schneider, Paris, France, through His Excellency, Jules J. Jusserand, Ambassador Extraordinary and Minister Plenipotentiary of France, represented by Brevet Major Dubreuil, Military Attaché to the French Embassy.

M. Schneider was presented to the president by John Vipond Davies,

M. Luigi Luiggi, Rome, Italy, through His Excellency Victorio Orlandi Ricci, Ambassador Extraordinary and Minister Plenipotentiary of Italy, represented by Commander T. F. Bernardi, Italian Consul General in New York.

M. Luiggi was presented to the president by John William Lieb.

Samuel Rea.

Mr. Rea was presented to the president by Col. William J. Wilgus.

Ambrose Swasey.

Mr. Swasey was presented to the president by Charles T. Main.

Howard A. Carson through L. H. Davis.

Mr. Carson was presented to the president by Harrison P. Eddy.

The usual business coming before the society at its annual meeting was transacted.

The following officers were elected: President (to serve one year), John Ripley Freeman, M. Am. Soc. C. E., Providence, R. I. Vice Presidents (to serve two years), Carl Ewald Grunsky, M. Am. Soc. C. E., San Francisco, Cal.; Robert Ridgway, M. Am. Soc. C. E., New York City. Directors (to serve three years), Clifford Milburn Holland, M. Am. Soc. C. E., New York City; Joseph Johnson Yates, M. Am. Soc. C. E., Jersey City, N. J.; Frank Edward Winsor, M. Am. Soc. C. E., Providence, R. I.; John Needels Chester, M. Am. Soc. C. E., Pittsburgh, Pa.; Arthur James Dyer, M. Am. Soc. C. E., Nashville, Tenn.; Walter Leroy Huber, M. Am. Soc. C. E., San Francisco, Cal.

Luncheon at McGraw-Hill Building was followed by inspection of the McGraw-Hill Publishing Company's plant. In the evening the president's and honorary members' reception was followed by a dinner-dance.

January 19, Morning Session—Society meeting. Subject, "Water Transportation." Speakers: Dr. Emory R. Johnson, dean, Wharton School of Finance and Economy, University of Pennsylvania, Philadelphia, Pa.; R. H. M. Robinson, president, United American Lines, New York, N. Y.; Winthrop L. Marvin, vice president and general manager, American Steamship Owners' Association, New York, N. Y.; Samuel O. Dunn, editor, *Railway Age,* Chicago, Ill.

For those not attending the transportation conference excursions were arranged to inspect the New York Stock Exchange in actual operation, and to visit one of the biggest foundation jobs undertaken in New York City in a long time, that of the $15,000,000 Federal Reserve Bank of New York City building, through the courtesy of the Foundation Company, as well as the Architects and the Bank Officials.

The afternoon motor bus trips visited the plant of the American Bank Note Company, where a great deal of foreign money and practically all American securities are printed.

The party was then conducted to the 240,000-kw. ultimate capacity power house of The United Electric Light and Power Company at the East River and 135th Street, where interesting construction was inspected. In the evening there was a smoker with light refreshments.

Afternoon Session—Society meeting. Subject, "Railroad Transportation." Speakers: Howard Elliott, M. Am. Soc. C. E., chairman, Northern Pacific Railway Company, New York, N. Y.; William N. Doak, vice president, Brotherhood of Railroad Trainmen, Washington, D. C.; F. A. Molitor, M. Am. Soc. C. E., chairman, Board of Economics and Engineering, National Association of Owners of Railroad Securities, New York, N. Y.; Edgar E. Clark, formerly chairman, Interstate Commerce Commission, Washington, D. C.

Evening Session—Society meeting. Address, "World Activities and Their Effect Upon the Engineer," by Frank A. Vanderlip, formerly president, National City Bank, New York, N. Y., followed by smoker.

January 20, Morning Session—"Highway Transportation." Society meeting. Subject, "Inspection." Speakers: Thomas H. MacDonald, director, Bureau of Public Roads, Washington, D. C.; Fred W. Sarr, first deputy, Commission of Highways, Albany, N. Y.; Col. William D. Uhler, M. Am. Soc. C. E., chief engineer, State Highway Department, Harrisburg, Pa.; William G. B. Thompson, Assoc. M. Am. Soc. C. E., formerly State Highway Engineer, Trenton, N. J.; Paul D. Sargent, M. Am. Soc. C. E., chief engineer, State Highway Commission, Augusta, Me.

Afternoon Session—Subject, "Financing and Bonding." Speakers: John N. Cole, commissioner, State Department of Public Works, Boston, Mass.; Robert S. Parsons, M. Am. Soc. C. E., general manager, Erie Railroad Company, New York, N. Y.; Jeremiah C. Finch, secretary, Commission of Highways, Albany, N. Y.; E. A. St. John, vice president, National Surety Company, New York, N. Y.; Edward C. Lunt, vice president, Fidelity and Casualty Company, New York, N. Y.; Frederick Stuart Greene, M. Am. Soc. C. E., formerly commissioner, Commission of Highways, New York, N. Y.; Harry Meixell, Jr., secretary, Motor Vehicle Conference Committee, New York, N. Y.

Evening Session—Subjects, "Administration," "Relation of Highway to Other Transportation Systems," "Motor Vehicle Control." Speakers: William D. B. Ainey, chairman, The Public Service Commission, Harrisburg, Pa.; Herbert S. Sisson, commissioner, Commission of Highways, Albany, N. Y.; G. Wythe Munford, inspector, Commission of Motor Vehicles, Baltimore, Md.; Harry Meixell, Jr., secretary, Motor Vehicle Conference Committee, New York, N. Y.

LEXINGTON REGIONAL HIGHWAY CONFERENCE

A conference for the study of Highway Economics and Highway Transport will be held at the University of Kentucky, Lexington, Ky., January 31, February 1, under the auspices of the University of Kentucky, the Highway and Highway Transport Education Committee of the United States Department of Education, and the Kentucky State Highway Department.

Program—January 31, 1922, Dicker Hall, University Campus, 2:00 p. m. The Relation of the United States Bureau of Education to Highway Development, by Dr. John J. Tigert, United States Commissioner of Education, Chairman Highway and Highway Transport Committee. The Future of Highway Transport, by E. S. Jordon, President Jordon Motor Co., representing the National Automobile Chamber of Commerce. Recent Developments in Highway Engineering Research, by Dr. W. K. Hatt, National Research Council.

Discussion.

Informal Dinner, Lafayette Hotel, 7:00 p. m. The Purpose of Highway Development in the United States, by Thomas H. McDonald, Chief of the Bureau of Public Roads, U. S. Department of Agriculture. Kentucky's Road Problem, by Joe S. Boggs, State Highway Engineer. The Scope and Purpose of Federal Aid in Behalf of Improved Highways and its Relation to the States, by Hon. John M. Robison, Member Congress, 11 District Kentucky. The Farmer and Good Roads, by J. M. Feltner, Member Agriculture Extension Division, University of Kentucky.

Discussion.

February 1, Dicker Hall

February 1. Possibilities of Maintaining Lower Cost Surfaces, by W. N. Bosler, Principal Assistant State Highway Engineer of Kentucky. Safety First Education in the Public School, by Miss Harriet Beard, Supervisor of Safety Education, Detroit, Mich. The Uses of the Highway, by Dr. J. G. McKay, University of Wisconsin. The Training of Engineers for the New Highway Building Program, by D. V. Terrell, Professor of Civil Engineering, University of Kentucky.

Discussion.

Report of Resolutions Committee.

CHICAGO ROAD BUILDERS' CONVENTION AND GOOD ROADS' SHOW

The Road Builders' Convention and Good Roads' Show, held in the Chicago Coliseum, January 17-20, had an unprecedentedly large attendance from all parts of the country and developed earnestness and enthusiasm for the best methods of financing, designing, constructing and maintaining highways, and for the materials, plant and equipment necessary for the best results. The exhibits were numerous, important and well presented, and the technical features of the convention were emphasized by the arrangement of the program so as to concentrate and classify principal interests in separate sections, which were devoted to Bituminous roads, Portland cement concrete roads, Common roads, Highway finances, Highway traffic and Transportation, and Highway research, all of which were conducted with special papers by experts as enumerated in the program published in PUBLIC WORKS January 14, page 36, and amplified and vitalized by the discussions by the practical and theoretical road builders present.

The congress opened in the Coliseum with more than 10,000 delegates in attendance. Among them were governors of 48 states and mayors of 4,730 cities and towns, either in person or represented by an official delegation. All Canadian provinces were represented and builders from all of the island possessions of the United States were also on hand.

A feature of the opening session was the personal message that Col. H. L. Bowlby, president of the American Road Builders' Association, brought from President Harding to the delegates, saying:

"There is now pretty nearly universal agreement that no single public improvement has done in recent years, or will do in coming years, more for the general good of the country than the development of our highway system. The task is an enormous one, but better methods both in physical construction and in the relations of the community to highway development have been taking form in a most encouraging way.

"Your organization has been a chief contributor in this direction, and it is with much pleasure that I ask you to extend to its members my best wishes for their continued success."

Letters were also read upon the opening of the convention from Brig.-Gen. Charles E. Sawyer and United States Senator Lawrence C. Phipps, of Colorado.

The congress program for the first day included an address of welcome by Mayor Thompson, an opening address by Col. Bowlby and a general discussion of highway paving types.

Col. Bowlby told the congress that the advent and development of the American Road Builders' Association has had much to do with making the industry what it is. He described its growth since organization in 1902 and asserted that the assocation could be made the most potent influence in highway development in this country, if not in the world.

Among the important resolutions presented to the convention was one endorsing 20 feet as the standard minimum width for laying highways principally because in addition to occupying space actually needed for traffic, the shoulders of narrow concrete roads are much more badly damaged by heavy vehicles overrunning on them, which also jeopardize the edges of the concrete which is likely to be much more broken than when the traffic is retained within a foot of the edge. The increased width of Bituminous roads will also tend strongly to prevent the development of ruts that are found in narrow roads.

It was generally admitted that the 18-foot standard is not only inadequate for present conditions, but is much too small for future traffic. A. W. Dean, chief engineer of the Massachusetts Highway Department, stated that Massachusetts is now specifying a 20-foot standard for main highways and preparing for 26-foot roads, as on the Boston Highway where the foundation is 26 feet wide, although the present wearing surface is only 20 feet. In districts where not more than 200 or 300 vehicles pass daily, 18-foot width suffices unless the traffic is chiefly of motor trucks. Motor trucks 8 feet wide overall are now in service on many highways and two of them cannot safely pass on an 18-foot roadway.

James H. MacDonald, former state highway commissioner of Connecticut, advocated for main highways a minimum of 20 feet travelway with a 5-foot ditchless shoulder on each side.

Frank H. Terrace, president of the Washington State Good Roads' Association, stated that although the cost of clearing and grading was sometimes very high in Washington, so that in certain localities it was necessary to restrict the road width to 16 feet, they made them wider wherever possible, and have constructed them up to 26 feet in width, and provide a right of way of 60 feet for all roads.

Alfred Dryland, engineer of Middlesex, England, was quoted as saying that within a few days he had ridden over more dangerous roads near New York than he had in England during 40 years, that the roads were dangerous on account of their narrowness and that the minimum width of pavement should be 30 feet, adding that if American traffic continues to grow, roads 150 feet wide, such as now exists between London and Edinburgh, will be required on American main trunk highways and especially near large cities.

E. D. Smith, of the United States Bureau of Public Roads, advocated a minimum width of 20 feet and stated that bridges were now recommended to be 22 feet and whenever possible 24 feet in width.

J. E. Pennybacker, former chief economist of the U. S. Bureau of Public Roads, and secretary to the National Association of Asphalt Producers, endorsed the demand for wider roads on account of the enormous increase of traffic, which when considering both vehicles and speeds on country roads amounts to 3,000 per cent. during the last 12 years. Although there is more paved surface there is little increase in actual mileage, and in order to handle the traffic there must either be one set of roads for fast and one for slow moving vehicles,

or the roads must be built wide enough to care for both. In large American cities the heavier travelled streets are in better condition than the intersecting and seldom travelled streets.

J. H. Mullen, chief engineer of the Minnesota Highway Department, announced that Minnesota has adopted a 20-foot standard for all roads in suburban districts and 27 feet for roads in congested districts and an 18-foot paved surface for little travelled 30-foot roads.

Mr. MacDonald was in favor of the construction of a 10-foot paved surface on one side of the center of a country road where traffic is light, to provide one traffic lane until requirements demand that it be widened for two lanes.

Prof. Arthur H. Blanchard, of the University of Michigan, urged a 20-foot minimum standard width as sane, efficient and entirely capable of handling traffic demands ordinarily made on the average well travelled country highway.

Major W. A. Welch, chief engineer of Palisades Interstate Park Commission, of New York, favored wider roads as a necessity for present traffic conditions, not only to give greater clearance for moving vehicles, but also for vehicles parked alongside the roadway which encroach seriously upon it. On the other hand he considered that too wide roads are death traps, because a 27-foot roadway permits cars to pass three abreast, making a danger zone in the middle of the road. A 20-foot roadway with a 5-foot shoulder on each side is sufficient clearance without being too wide for safety.

M. O. Eldridge, director of roads of the American Automobile Association, pointed out that the increase of automobiles from 700,000 in 1911 to 10,000,000 now, demands wider roads that will last longer and cost less for upkeep than narrow ones.

C. M. Upham, chief engineer of the North Carolina State Highway Commission, and secretary of the American Association of State Highway Officials, favored 20-foot standard on all main lines and other lines with dense traffic, and stated the cost of shoulder maintenance of an 18-foot roadway when added to the cost of the roadway itself greatly exceeds the cost of a 20-foot road and its maintenance. The width of the road should be increased with the increase of traffic, allowing at least 10 feet for each lane of traffic.

Resolved, That the American Road Builders' Association heartily endorses the action of Congress in adopting a policy of federal aid for highways to be applied to a definite system of highways as provided in the Federal Highway Act which went into effect November 9, 1921.

We pledge our hearty and unqualified support to the Federal Bureau of Public Roads in carrying out the provisions of said act.

Inasmuch as the act contemplates continued federal participation with the states in highway improvement, we realize and emphasize the absolute necessity of a definite policy projected far enough into the future to make possible the economic and satisfactory planning and carrying out of the intent and purpose of the act.

To this end we endorse R. R. 8978, introduced by the Hon. Roy Woodruff, which bill authorizes the appropriation of $100,000,000 annually for five years beginning July 1, 1922, as a general federal aid appropriation, and we also urge that adequate provision be made in the said bill for the continued development of highways in and adjacent to the National Parks, forest areas and Indian reservations and the Territory of Alaska under unified control.

The adoption of this five year program is necessary to enable the states, through their legislatures, to make proper provisions for the requisite state cooperation in this enterprise.

Resolved, That the American Road Builders' Association urges upon the Interstate Commerce Commission and upon the various state railroad commissions (or equivalent state bodies) the importance of a review and comparison of the present rates on road materials and on other commodities, to the end that present existing inequalities may be removed and the taxpayers' interests protected.

Resolved, That the American Road Builders' Association pledges itself collectively and as individuals to use its best efforts to speed up the properly planned elimination of grade crossings, to the end that all of them, especially on the main traveled highways, shall be eliminated as rapidly as funds can be made available by the public and the railway companies.

Resolved, That we condemn, as against public policy, the present attitude of negation adopted by too many railroad companies and by too many state railroad commissions, because such attitude has resulted in the slackening of elimination work at a time when the protection of the traveling public is much more urgent than ever before.

Resolved by the American Road Builders' Association in convention assembled, that the efforts by the various committees that are now working to solve the problem of finding a method of stabilizing subgrades and completing the study of the relationship of subgrade to traffic and road surfaces should have the hearty support of this association, and that every assistance be rendered from whatever source to speedily assist in solving this problem.

Whereas, It has come to the attention of this Association that "Public Roads," the monthly magazine of the Bureau of Pub'ic Roads, has been indefinitely suspended together with other government periodicals, and

Whereas, "Public Roads" is a necessary medium to disseminate the results of highway research and for the interchange of opinions and ideas between the U. S. Bureau of Public Roads and the Highway departments of the several states in connection with the administration of cooperative highway construction under the Federal Highway Act.

Resolved, That the American Road Builders' Association endorses "Public Roads" as heretofore issued, and urges that its publication be immediately resumed.

Resolved, That the American Road Builders' Association pledges its support to any proper movement to eliminate advertising signs along or adjacent to public highways and urges upon its individual members the importance of aiding and encouraging legislation in all states to effect said elimination, to the end that our highways may be fully and safely occupied and enjoyed by the public, for the use of whom they are acquired and built.

Resolved, That this organization pledges itself to work for efficiency and permanency in the personnel of all departments engaged in highway improvement for the elimination of partisan politics from the operation, and for the reward of ability wherever found.

Resolved, That the American Road Builders' Association welcomes the establishment by the National Research Council of the Advisory Board on Highway Research and that the Association pledges its support to the Advisory Board in this much needed effort to stimulate and co-ordinate highway research.

Resolved, That the American Road Builders' Association, assembled in Chicago at its 19th annual convention, petition the President to take such steps as may be necessary for the Government of the United States of America to become a member of the International Road Congress.

Whereas, It is the experience of road engineers that eighteen foot pavement widths carrying dense traffic in the vicinity of large cities are not adequate,

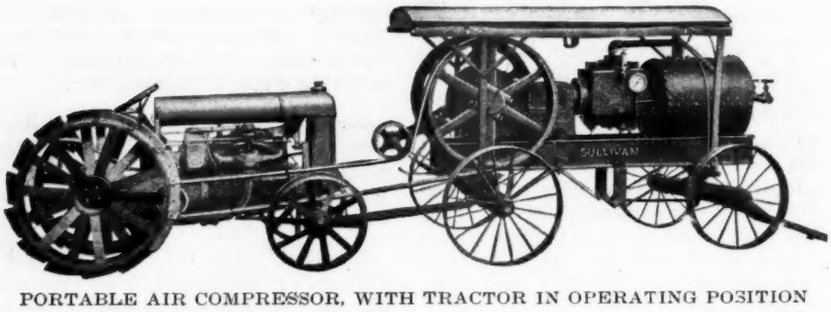
Resolved, That the American Road Builders' Association go on record as favoring a pavement width of not less than twenty feet for all trunk highways or roads carrying dense traffic.

Resolutions of thanks to Col. H. L. Bowlby and to the United States Bureau of Public Roads were carried.

From the standpoint of the exhibitors the road show has been a success, Lieut.-Col. H. L. Bowlby, president of the association, reported, when more than $2,000,000 in sales had been recorded.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



PORTABLE AIR COMPRESSOR, WITH TRACTOR IN OPERATING POSITION

PORTABLE AIR COMPRESSOR OPERATED BY TRACTOR

The Class WK-34, portable belt-driven air compressor, manufactured by the Sullivan Machinery Co., is a standard 8 x 8-inch straight line belt-driven air compressor with a displacement capacity of 121 cubic feet of free air per minute and designed to run 250 rpm and furnish air at 90 pounds pressure. It is intended to be belt driven from a tractor which will need to transmit about 18 h.p. to operate the compressor to its rated capacity. The compressor is mounted on a steel truck having wheels with a wide face and a 4-foot 8-inch track gage, and weighs about 4,100 pounds.

The compressor is designed and operated by a Fordson or other similar type of tractor, to which it is attached by a distance piece or connection bar for the proper belt tension when in service. The same tractor that operates the compressor is used for hauling it from place to place, in which case both the tractor and the compressor are reversed, end for end, from the operating position shown in the engraving.

WOOD HYDRAULIC HOIST AND BODY

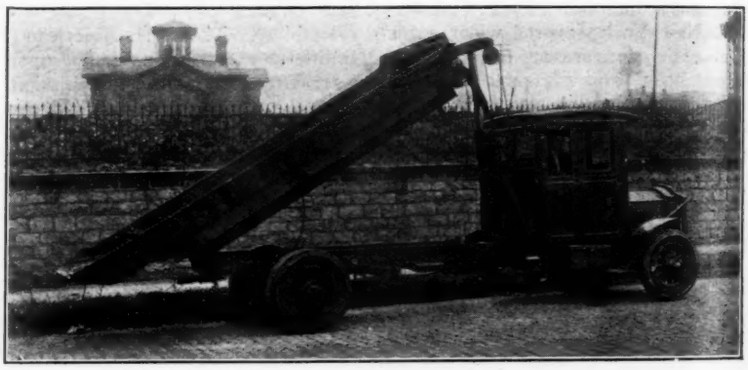
The 2-yard garbage body, type G-25, is built special by the Wood Hydraulic Hoist and Body Company, to conform with city laws and ordinances and is shipped complete, ready for attaching. It has been necessary to develop this special type of body for handling garbage because there is considerable liquid contained in the garbage, and because garbage tends to slide from the body in one compact mass. It is difficult to use a hinged tail gate on a garbage body, as the gate must be watertight. Therefore the rear end of the body floor is inclined or tapered for the full depth of the body, thus eliminating complicated tail gate mechanism.

The inclination at the end of the body is approximately 20 degrees, an angle which will allow a sufficient slope when the body is fully elevated so that the body contents will slide out freely. Garbage bodies must be equipped with some form of covering to hide the unsightly load and prevent spilling of some of the contents. In some cases, hinged steel covers, made in sections so as to be absolutely tight and easily operated and to uncover only a portion of the body at a time, are used. The rear end hinged covers are arranged to open and allow the load to discharge when the body is elevated.

Another widely used form of covering consists of canvas tarpaulin rolled on a stick or rod. As the body is filled, the tarpaulin is rolled back to cover the load and tied down tightly to hooks or rings on the body sides. The tarpaulin cover is easily operated and will adapt itself to inequalities of the body load. The tarpaulin is easily handled, is not subject to mechanical defects and will be free from the noise or rattle of the hinged steel covers on an empty body.

This garbage body is widely used by Municipalities and is manufactured in smaller sizes for the Ford one ton truck and for the Reo speed wagon. These smaller garbage dump trucks are very popular with Municipalities, their short wheel base adapting them particularly for service in narrow and winding alleyways.

The same company produces the Wood-Detroit Vertical Hydraulic Hoist and the Horizontal Hydraulic Hoist and has developed a new Under Body type, now in production, for the smaller vehicles such as the Ford, Reo and light one ton trucks.



GARBAGE BODY WITH VERTICAL HOIST

GARBAGE BODY WITH HORIZONTAL HOIST